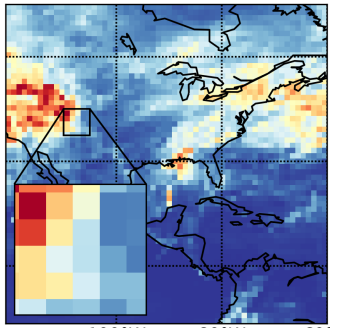
Super Resolution Based Downscaling of ESM Data with a Novel Convolutional Neural Network

Objective: To use a novel deep learning method called fast super-resolution convolutional neural network (FSRCNN) to downscale Earth System Model data

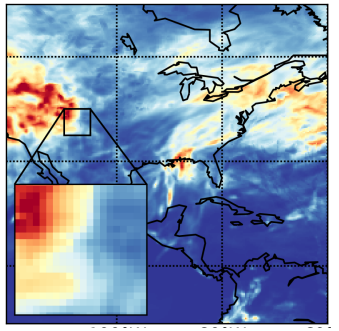
Approach: We train a FSRCNN to downscale five surface variables simultaneously using coarsened (100 km) E3SMv1 high-resolution version's model data over North America to reconstruct high-resolution (25 km) data. Further, we modify the network to create a new network design called FSRCNN-ESM, which includes an additional patch extraction step with non-linear mapping to improve accuracy.

Results/Impacts: FSRCNN-ESM's reconstruction of high-resolution spatial patterns demonstrates better skill at downscaling surface temperature, radiative fluxes and precipitation as compared to FSRCNN and other machine learning methods, while also being computationally less expensive to train.

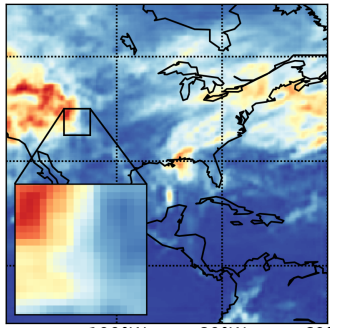
Low Resolution Data



High Resolution Data



Super-resolution Reconstruction



An example of downscaling/reconstructing (bottom) monthly surface temperature of a high resolution E3SM model simulation (middle) from its coarsened low resolution data (top) using a novel super resolution approach (FSRCNN-ESM).

L. Passarella, S. Mahajan, A. Pal and M. Norman (2022): Reconstructing high resolution ESM data using a Fast Super Resolution Convolutional Neural Network. ***Geophysical Research Letters (accepted),*** https://doi.org/10.1029/2021GL097571.